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Crop and Field Cost Accounting on Hawaii's Sugar Plantations

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Editorial Department Note

In accordance with our publication program, we will issue from time to time, papers dealing with the accounting problems peculiar to an industry or an individual member of an industry. Due to the relatively small space available in the Official Publications, it is manifestly not possible to describe a complete system of accounting applicable to an industry, nor is this the purpose of these publications. Those of our members employed in an industry are chiefly interested in the controversial points of accounting theory or practice applicable thereto and those not so engaged desire, as a matter of general information, a knowledge of those accounting features which are peculiar to the industry. This is, therefore, the "raison d'etre" of this class of publications.

The present publication deals with features of the Hawaiian sugar growing industry. It should be noted that our Official Publication, Volume VI, No. 5, by Mr. F. L. Crawford dealt with the domestic beet sugar industry.

Mr. Rudolf Muller, the author of the present publication, has been identified with the sugar industry of Hawaii in one capacity or other since the fall of 1895 when he first came to Hawaii. He gained his practical experience in plantation work on Kauai and Maui plantations, where he acquired knowledge of factory work by a course in the laboratory and at sugar boiling. Between grinding seasons he was engaged in every phase of field operations as overseer. He began the study of accounting a few years later, and became bookkeeper for one of the large firms of commission merchants and sugar factors in Honolulu. In 1906 he joined the office staff of the Ewa Plantation Company, on the island of Oahu, 18 miles from Honolulu, the world's record producer in yield per acre. Here he was engaged as payroll clerk, cost clerk and statistician, bookkeeper, and cashier. In 1913 he became chief accountant and office manager and has held that position ever since.

CROP AND FIELD COST ACCOUNTING ON HAWAII'S SUGAR PLANTATIONS

History and Development of Industry

Before going into a detailed discussion of the subject-matter of this paper it may not be amiss to take a leaf from the past and recall some of the early history of the sugar industry in these islands. From the early years of the nineteenth century foreign adventurers, chiefly Chinese, had made crude attempts to make both molasses and sugar from cane; but the first intelligent effort to establish a sugar factory was made by Ladd & Company, an American firm, which in 1835 acquired some land at Koloa on Kauai and two years later built the first iron sugar mill. This was first propelled by mules, then by water, and finally by steam.

A small quantity of sugar, presumably from this Koloa Mill,

Note. The material relating to the early history of the industry is taken from an article by H. M. Whitney in November, 1895, issue of Planters' Monthly.

was shipped from Honolulu in 1837 and constitutes the first export of this commodity. It is noteworthy that the plantation at Koloa (Koloa Sugar Company) is to this day a prosperous sugar enterprise, though its fields have been tilled and cropped for ninety years.

Up to 1875, fifty years ago, growth of the industry was steady, but slow because of lack of capital. The mills were primitive, mostly, using open kettles for boiling. In 1876 when the reciprocity treaty with the United States went into effect, exports had reached about 18,000 tons and under the stimulus of this treaty increased rapidly in the next six years, reaching 57,000 tons in 1882 and 150,000 tons in 1895, produced by 60 sugar estates. Those of us who were in Hawaii at that time will recall how proud we felt of this, then, phenomenal achievement.

To-day, only thirty years later, Hawaii produces five times that amount and is straining every effort to better even that. These results are the more remarkable when it is considered that they were brought about, not so much by increases of cultivated area, as by highly skilled, scientific methods, both in field and factory. Practically without exception Hawaii's sugar plantations have to-day reached a high degree of development and represent a capital investment of considerable magnitude. Most of the sugar estates are complete entities within themselves, in that they plant and raise their cane as well as convert it into sugar at their own factories. They give employment to upwards of 42,000 people and are fully equipped to take care of every need along construction and repair lines.

Accounting Methods

To keep pace with this physical growth and to reflect properly on the books of account the manifold activities and often involved operations, it is natural that the hit and miss accounting methods of early years have had to be displaced by a system especially adapted to the peculiarities of cane and sugar production. Sugar cane requires, on an average, from 18 to 22 months to mature. Planting and cultivation of cane on the available land is therefore so arranged that about one-half of the total growing cane ripens during any one year, thus making possible an annual crop with a consequent annual revenue from the sale of its sugar and by-products.

It is evident from the foregoing that to deduct from this revenue the expenses incurred within the fiscal year would not disclose the true profit on the crop responsible for the income, since, as stated above, the cost of producing it extends over a much longer and different period than the twelve months of the fiscal year. For these reasons the so-called "'crop system" of accounting has been evolved and is in general use throughout the islands. The system is recognized by the federal and territorial governments in returning income for tax purposes and it rests on the principle of establishing as profit from the operations of a given fiscal year—

usually the calendar year—the difference between the receipts from the sale of the product or products and the cost of their production plus delivery to market.

To determine correctly, this cost of production for each successive crop, several sets of separate crop accounts must be maintained concurrently, each of which will show at any time the value of its respective crop. This is accomplished by a monthly segregation of all operating expenditures—labor, materials, and sundries—and a distribution of the various items of expense first over crops and subsequently over the individual fields.

As a rule there are three crops at various degrees of progress to be dealt with within each fiscal period—the current year's crop, in progress of harvesting; the growing crop, to be harvested the following year; and the young crop, springing from the stools of the cane just harvested or from seed cane planted that same year and to be harvested two years hence.

Classification of Plantation Activities

It seems advisable at this point to describe in brief outline the functioning of the entire plantation machinery so as to aid in a clearer conception of the details to follow. The activities of most of the larger plantations may be classed in five main divisions:

1. Operations concerned directly with the production of cane and sugar.
2. Construction work incidental to carrying on work under class (1).
3. Merchandising and ranching.
4. Health, welfare and order.
5. Accounting and statistics.

Class 1, Cane and Sugar Production

This sub-divides into field and factory functions.

Field Work. Of the former these are the principal ones and apply to irrigated plantations:

Clearing of new lands; steam plowing to desired depth; furrowing by means of moldboard plows, drawn by tractors or mules; cutting of seed cane from other suitable growing fields; bagging and transporting same to planting field; placing seed into furrows, covering, and applying first water. Ratoon fields of course, do not require these initial operations. After cleaning up and repairs to water courses, ditches, and gates, they are ready for the first round of irrigation.

Plantations obtain their water supply from various sources. Some, particularly on the island of Hawaii, depend entirely on rainfall; others partly so. Some own elaborate ditch and tunnel systems, delivering mountain water; others buy their water from ditch companies: Still others draw on the artesian supply by means of steam or electric pumps, which is very costly. Whatever the source, water is the life blood of plantations and is systematically

applied in well defined rounds throughout the growing period of the cane. During that time the fields receive also periodical applications of fertilizers, the composition of which is based on the plant requirements and the type of soil. In localities where rains are abundant or where drainage is poor, the rapid growth of weeds presents a problem and their constant removal becomes quite a cost factor.

Proper selection of seed for new plantings, irrigation, and fertilization are of utmost importance in cane production. This is thoroughly recognized by the various managements, many of which maintain agricultural research departments for the study of local conditions and the specific methods of treatment called for.

Harvesting of the mature cane is the next step. This entails, prior to cutting, the burning off of the trash from the stalks; cutting of the cane; and the laying of portable tracks through the fields for transportation of the loaded cars to the main railroad lines. All the cutting is still done by hand, none of the many inventions of mechanical devices having proved practical so far. The same applies to loading, though at least one of the large plantations has employed a certain type of machine for this work during several seasons and has found their use very advantageous.

Once the cane is cut, speed in delivery to the factory becomes a vital factor, since deterioration sets in rapidly and spells loss. Sufficient locomotives and rolling stock equipment are therefore necessary to convey the cane to the scales and carriers of the factory or "mill."

Factory Work. Here the huge roller mills crush out the juice which, after various phases of treatment, enters the vacuum pans as syrup and is boiled until it crystalizes into sugar. Centrifugal machines then effect the separation of grain and molasses, a process called "drying," and discharge the finished product—raw sugar—by various contrivances into its final containers, the stenciled bags, ready for immediate marketing or storage, according to local conditions and circumstances.

Practically all plantations maintain fully equipped laboratories, whose chemists control the total process of milling and manufacture and compile daily and periodic reports containing all required data in this connection.

Between seasons the entire plant undergoes a complete overhauling in preparation for the next grinding season. At that time also any alterations or improvements usually are made.

Both steam and electricity furnish the motive power for driving the mill and shop machinery and lighting these plants. Where large turbo-generators are in use their services extend towards supplying current for lighting all other buildings and thoroughfares as well as light and power for employees' homes.

Class 2, Construction Work

Important under this head are the various units comprising

the irrigation system and necessary for its successful operation. These are pump wells and plants, pipe lines, reservoirs, flumes, and waterways.

Road building, bridges, trestles and railroad construction are required for adequate transportation. For transmission of power and communication by telephone pole lines, must be erected. A force of carpenters, painters, and plumbers is constantly at work in repairing the homes of employees or building new homes when the need for such arises, together with water and sewer connections. Repair shops are an absolute necessity, and on the large plantations these are able to take care of most of the work.

Class 3, Merchandising and Ranching

In order to satisfy the daily needs of its employees, every plantation maintains at least one general store. Of late many have added ranching and dairying to their facilities, so as to be able to sell their workers meat and milk at nominal prices.

Class 4, Health, Welfare and Order

All plantations provide medical attendance for their people. A large number have hospitals with modern equipment and a resident physician as well as nurses. Inspection of village sanitary conditions is one of the physician's duties.

Homes, water, wood, or oil fuel are furnished free.

Kindergartens, nurseries, and playgrounds are not uncommon; they offer relief to mothers who wish to work.

Sports activities, clubhouses and motion picture shows are generally in charge of a trained welfare worker and afford recreation after working hours.

Order and discipline are maintained through the supervision of a special police officer and deputies.

Class 5, Accounting and Statistics

The means by which the foregoing activities are controlled, recorded and classified, the mirror which should reflect a clear and comprehensive picture of the status of the business, is the accounting system. Its accuracy and therefore its value depend on the accuracy of the basic information on which it rests, namely, the reports on labor performed and materials used. While different plantations employ different methods in obtaining their information and in treating it, they agree pretty well in fundamental principles. It must therefore be clearly understood that the system here described is by no means held to be the only road to salvation, but it is in use in more or less this form on several large plantations and with minor modifications on others.

Labor Records. The prime source of information for all work performed is the timebook. This may be made to serve merely the purpose of recording the time of the working force for subsequent computation of payrolls, or its utility may be greatly enhanced by

making it a combination record of time and of field distribution. This is best done by the use of symbols, either numeric or alphabetic, and a timebook designed on the loose leaf principle.

For each account there is a corresponding symbol and the timekeeper uses this, when crediting time to the individual worker, instead of the customary stroke. A valuable occupational record for compiling labor statistics is thus developed simultaneously.

At the back of the timebook provision is made for distributing the time over fields, which in the aggregate must tally with the individual time credited to the workers. To illustrate: Assume that 100 men are weeding in fields A, B, and C, receiving each a fixed rate per day of $2.00; that there are three overseers at a wage of $4.00 per day each; that the symbol for "weeding" is "W" and that 30 men work in field A and 35 each in fields B and C. The timekeeper would then proceed to place a "W" against each of the 100 men and each of the three overseers on the date the work was done. He then accounts for these 103 man days by entering under Field A at the back of the timebook on the margin the symbol W and the rate—$2.00 in this case—and in the proper date column he enters the 30 man days. On the next line he records another W and the rate of $4.00, the overseer's, and in the day column one day. Fields B and C are in the same manner each charged with 35 days "W" at $2.00 and with one day "W" at $4.00, thus completing the field charges.

It will be seen that in following this procedure all time credits for field operations will be balanced by a charge against the proper fields.

To provide a method of checking the total time posted each day a small tally sheet can be inserted in the timebook on which are entered the accounts in symbol form and the aggregate totals in man days of each group of workers as their time is being taken. This little sheet can be arranged in nationalities and sub-divided into men, women and minors and thus readily serve for compilation of a daily turn-out report to the manager.

After each day's time entry has been proved correct by agreement with the totals of the daily tally sheet, the days shown thereon against each account are transferred to a cumulative record of days. As will be seen later this record is necessary in order to reconcile the labor pay roll with the distribution of this labor over accounts.

At the end of each month the time is counted and posted into the pay roll sheets, together with the rates of pay. Both pay roll and timebook are then simultaneously extended and checked one against the other to insure accuracy.

The above applies to day labor. For contract work the procedure is somewhat different. The earnings for this class of labor, being based on individual performance, are usually computed from separate records.

A distinction is made between short term contracts and long

term contracts. The former, as the name implies, comprise all contracts of short duration and for which full settlement is received at once. Long term contracts are those which by the nature of the work extend over a long period of months, at the end of which final settlement is made.

Cultivation contracts are of the latter kind, while loading cane, cutting cane, bagging and loading sugar, fertilizing, construction work, etc., are of the short term type.

These contract earnings are posted direct to the payroll from the special contract records compiled and the payroll may then be completed in the usual manner.

Pay days occur once each month, usually on several days during the early part of the month, so as to allow time for completion of the computations and writing of pay envelopes.

The timebook now enters its second stage of usefulness. A glance at its pages will at once disclose the advantage of the symbol system, for it shows exactly the kind of work done by each worker during the month. This not only helps in adjusting claims and tracing work records, but furnishes the basis for, and facilitates the segregation of, the month's day labor, according to operations and their cost, and this is the first step towards the preparation of a complete distribution of labor over accounts.

It might be well to explain here that under the wage system as adopted in Hawaii, totally unskilled laborers, when first imported, receive a so-called base rate, i.e., an irreducible minimum, until their skill improves. The percentage working at this base rate is small.

When making the above mentioned segregation, all work at base rate is ignored, so that the finished summary represents the prime cost of every class of day labor done at other than base rates, including overtime. These days and amounts are then posted on a specially designed distribution form in a column provided for these figures.

The arrangement of this labor distribution form permits the assembly in columnar form of all other labor items, not included in the segregation of rates obtained from the timebook, such as all contract labor, salaries, and labor paid for at base rate. This latter is ascertained by a process of elimination and serves as a check column on all the work so far, since any errors made will be inevitably shown up.

The figures for the base rate column of the labor distribution sheet are found in the following manner: From the grand total of the record of days, accumulated during the month as explained above, should be deducted the total man days so far appearing as footings of the other completed columns. Obviously the remaining days must be those earning the base rate, since all other days have already been accounted for. The same process, applied to each account, will give the base rate days for that account, the sum of which should add to the total previously found, as above described.

Multiplication of these days by the base rate will complete the column.

If no error has occurred in any of the phases of this distribution work, the sum of all amount column totals should agree with the gross payroll disbursement. It is advisable to make this test before extending the individual items in the base rate column, so as to locate discrepancies, if any, and thus save doing some of the work twice.

When agreement has been established the final labor costs, both in time and values, may be carried out for each account in the total columns provided on the form, unless shop distributions are embodied, in which case the following procedure is to be observed.

Another feature which may be made a part of this distribution sheet is the allocation to the various accounts of the labor portion of repair shop expenses and such other departmental activities as, on account of their diversity, require a more exact time division than days or fractions of days. These include such items as plumbing, civil engineer's, electrician's and auto repair, and upkeep departments, as well as the machine and blacksmith shops.

These departments report all their time to the timekeeper under a specific symbol, but keep a detailed record, in hours and fractions thereof, of the class of work done daily by each individual worker. These records are summarized by accounts and the aggregate hours shown against each account—reduced to days—used as basis for prorating overhead within each of these shops or departments, as well as materials and supplies consumed in their operation, these latter items, however, being journalized separately.

The "shop distribution," as it may be called, completed, the items are posted on a transfer column of the labor distribution sheet, offsetting in the aggregate the totals for each shop, listed in other columns under their respective shop symbols.

Cross additions of the items shown against each account will yield the final totals of days and amounts and complete the distribution of the entire labor cost.

Material Records. Orders for materials are with few exceptions placed with the agents of the various plantations, who in turn have these orders filled either locally, or on the mainland.

Many such requisitions are for materials to be used for specific jobs or operations which will consume them entirely. There is no objection to charge such materials direct to these jobs or operations. Indeed it is preferable, because simpler, to do so, whenever it is certain that materials will be used as charged.

To conduct plantation operations successfully, however, it is necessary to have on hand large quantities of supplies of all kinds. These are charged to a "Stores" or "Supply" account, and, when received, find their way into a storehouse, in charge of a storekeeper or warehouseman who records receipts on his stock cards together with invoice costs and freights. Supplies are issued against requisitions, signed by authorized foremen, who indicate

the account and job number to which the materials should be charged.

Invoices covering both specific and supplies orders, after checking and adding corresponding freights, are journalized, usually in specially designed books. The methods of dealing with materials do not differ greatly from those employed in most manufacturing plants.

Types of Accounts

The types of accounts used on plantations are the standard groupings of accounts found in any accounting system. They are:

1. Asset, liability, and proprietorship or capital accounts.
   These are always open on the books to show the proprietorship equation.
2. Economic accounts.
   These are of a temporary nature; they analyze the changes taking place in net worth for any accounting period and are closed into Profit and Loss at its end. They may be sub-divided as follows:
   a. Primary income accounts.
      Sales of sugar and molasses come under this class.
   b. Secondary income accounts.
      Recording income of miscellaneous and incidental nature, such as sales of scrapped materials, water, electric current, etc., the receipt of interest and the like.
   c. Expense accounts.
      These again are divided into three classifications:
      (1) Production costs.
      (2) Marketing expenses.
      (3) Other expenses.

Of these the first two are opposed to the primary income accounts and reflect the cost of obtaining that particular income.

The third classification embraces those items of expense or loss which have to do with the financial affairs of the plantation and such expenses as are not properly chargeable under the other classes.

Here, we are concerned mainly with production costs, since these must be allocated to the various crops in progress during any one accounting period.

Production Costs. Production costs are of two kinds. Direct costs and indirect costs. The former comprise labor and material expended directly in the process of production of either cane or sugar; indirect costs are incurred in operations essential and therefore chargeable to production, but cannot be directly and distinctly connected with any one specific operation of the production process.

The following grouping of the principal operations which are included in the cost of production is generally accepted and will elucidate the above definitions. Number and titles of accounts,

of course, vary, each plantation adapting these to its own particular conditions and requirements.

Under direct costs we have:

GROUP I, Preparation and Cultivation. Clearing expense; steam plowing and repairs; preparing; cutting seed; hauling seed; seed cane; planting; pumping and repairs; delivery of water (pipe line, flume, reservoir and ditch expenses); irrigating; weeding; fertilizing.

GROUP II, Harvesting: Burning; cutting; loading; hauling; portable track.

GROUP III, Manufacturing: Mill expense and repairs; laboratory expense; containers.

The indirect cost groups are:

GROUP IV, General Repairs: Buildings; fences; roads and bridges; pole lines; water mains; sewers; telephones, etc.

GROUP V, Sanitation: Cleaning camps; medical expense.

GROUP VI, Overhead and General Expenses: Accrued rent and taxes; office expense; H. S. P. A. dues; domestic fuel and water expense; insurance; agricultural research; incidental expense; legal expense; welfare work, etc.

GROUP VII, Distributive Accounts: Locomotive expense and repairs; rolling stock repairs; railroad repairs; stables; tractor expense and repairs; administration; shops; turnout bonus, etc.

Most of the foregoing captions or titles indicate clearly the nature of transactions or functions which should be charged to them. A few require comment.

Clearing Expense. This embraces merely the cleaning-up work necessary to put the fields in shape for a new crop. It should not be understood to include the clearing of virgin lands, prior to placing them under cultivation. Such work, being in the nature of a permanent improvement, creates new values, and is therefore a capital expenditure.

Seed Cane. The cane used for seed in planting and replanting operations should be charged at cost at the time these operations occur, which is practically every month. As it is not feasible in most cases to ascertain the exact costs of such seed cane at that time, a good plan is to put the cut tonnage through the books at an approximate costs estimate, crediting "Deferred Charges" account. After the actual cost of both body and top seed has been computed, say at the close of the year, an adjustment of the previous estimates to actual costs can be easily effected.

Accrued Obligations. In order that the manager or directors of the plantation may have available at any time a proper statement of affairs, it is quite important that, as far as practicable, all accrued obligations to and of the company should be carried on the books.

This principle finds application in the treatment on the books of the long term cultivation contracts operative under Group I, and rent and tax payments under Group VI.

Outstanding Labor Contracts. The bulk of cultivation operations—irrigating, weeding, and applying fertilizers—is now performed under long term contracts, the contractors, a specified number of them to each field, undertaking to bring the cane to maturity. During the term of the contract they receive a living wage advance and a fixed unit price, usually based on tons of cane raised, as determined at its termination. It is possible to anticipate the final average rate of earnings per day very closely. The difference between this expected final rate and the rate paid monthly as living wages should therefore each month be charged pro rata to the operating accounts affected and a corresponding credit passed to an account suitably captioned to express the liability. In this way these costs are placed at the time they actually occur and the fact and amount of the pending final payments cannot be lost sight of.

Should the final settlements in any one contract exceed the early estimates, the additional amounts paid must, of course, be charged to the operations concerned in the same ratio as the original estimates. In case of earnings being below the estimated figures the process is reversed.

Treatment of Rent. Rent and Property Taxes, which form a considerable cost factor and payments for which are usually made only twice a year should be so treated on the general ledger as to show their cost at the end of each month.

This is accomplished in the case of rent by charging at the beginning of every year to rent account the whole of the rent for the year (estimated conservatively, where rentals are based on a percentage of the returns from the sale of sugar) and crediting this to "rent payable" account.

That part of the total rent which is based on a percentage of returns, being wholly chargeable to the current year's crop, should then be debited monthly to operating expenses in such proportion as the numeral, 1, bears to the number of months which it is expected it will take to harvest the crop; the corresponding credit being made to rent account. In this manner, it will be seen, the charge for rent becomes a current one and when the harvesting is completed the crop stands charged with the whole rent; save for such adjustment as may be found necessary on final settlement, and this should not be large in amount

Any unexpected lengthening or shortening of the grinding period would undoubtedly become apparent soon enough to enable a corresponding decrease or increase to be made in the amounts charged monthly, so that at the end of the grinding season the crop would still be charged with the whole rent, as originally contemplated.

The remaining fixed part of the total rent, which is chargeable to several crops, should be charged monthly to operating expenses in twelve equal amounts and distributed to the several crops on the basis of the respective area for each. It follows that the current year's crop will be charged in diminishing ratio; that

of the next year, generally a fixed amount; and the crop following that, in an increasing ratio, changing as the land is cleared of one crop and used for another.

Treatment of Taxes. Property taxes are properly charged against cost of production, and, being levied on the assessed valuations of the enterprise as a whole on January 1st of each year, they should be spread over the then outstanding crops in field in the proportion that each crop bears to the total expenditure to date on all crops. The whole amount to be paid for the year should be charged to taxes account on the general ledger, and "taxes payable" account credited.

The amount chargeable to the current year's crop, calculated as above indicated, should then be charged monthly to operating expenses in the same manner as rent; so that, when the crop is all harvested and manufactured, it will stand charged with the whole of the taxes for the year. The remarks made in connection with rent, as to possible adjustments, apply here also.

The amounts to be borne by the succeeding crop or crops, also calculated as above, should be charged thereto and to operating expenses in equal monthly instalments. It is, of course, obvious that the corresponding credits being made to taxes account, the latter will close at the end of the year.

Payments made as they come due, for both rent and taxes, will under this plan be charged to the respective "payable" accounts, which will, of course, close when all payments have been made.

Income Taxes are, as their very name implies, a charge against profits and should take their place with other items of similar character in the profit and loss account.

Insurance on Stored Sugar. Insurance premiums on stored sugar are not chargeable to "insurance" account in Group VI. Sugar storage is an element of marketing expense, being occasioned by certain marketing conditions. The paid protection of the sugar, while in storage, becomes therefore properly a part of the storage cost.

Deferred Charges. Under the crop system of accounting, all production costs of labor and material ultimately find their place in the field cost accounts, the fields operated during any one month being burdened, normally, with the labor and material charged to operations on the general ledger that month. For this reason it is important, when ordering larger quantities of certain materials than can be consumed within the course of a month, to charge such materials to "deferred charges" account, although the use to be made of the materials is clearly defined. Cane knives, for instance, are used for cutting cane or seed and could therefore be charged at once to these operations. If, however, a large supply of these were ordered in January to last for the balance of the season, it would be manifestly incorrect to distribute the entire

cost of these knives to the few fields which happen to have been harvested in January.

By placing such items in deferred charges, an equitable distribution of them can be made over operations, crops, and fields at the end of the year.

Distributive Accounts. Let us now assume that all transactions for the month have been recorded on the general ledger, that a preliminary trial balance has been taken and a statement prepared, segregating the labor items in each operating account from the material and other expenses.

There remains one more feature to be completed before proceeding with the determination of crop and field costs. This is the closing out of the accounts constituting Group VII—Distributive Accounts.

The operations under this group are, with the exception of administration and turnout bonus, of an auxiliary nature and are more or less directly instrumental in effecting the functioning of most of the operations of the six preceding groups. It is therefore proper that they should be merged with them. On this point there is general agreement. Opinions differ, though, on the question of how often the merging process should take place. Some advocate a monthly distribution; others prefer to make it quarterly; still others think that once a year is often enough. No doubt the champions of these different methods can advance many arguments in favor of each point of view, but it seems indisputable that, if completeness and a maximum of accuracy are desired, the defenders of a monthly distribution should be pronounced the victors.

The first four accounts of the group are closely related, constituting the operation and upkeep of railroads and rolling stock equipment. Their aggregate monthly cost is therefore distributed on one basis, that of service in hours given by the locomotives to each operation. The locomotive drivers make daily reports which, when summarized at the end of each month, furnish the desired hour basis.

It should be noted here that the hours spent in hauling labor to and from their respective places of work must be redistributed over the operations requiring the labor, using as a basis the man days shown against these operations. The hours so found are then added to the hours, if any, previously placed against these accounts.

The next item is stable expense. The logical basis for the distribution of this cost is the number of animals employed at the various operations. A daily record of these can be conveniently kept in the time-book and posted monthly to a separate record form arranged to serve throughout the year.

The various classes of work done by tractors and the time expended is also made a part of the time-book records. The total costs under this head are then prorated on the day basis so found.

In the preparation of the "distribution of labor" all salaries which could be definitely allocated to any particular operation were already so dealt with. Administration expense therefore represents generally those supervision costs which should be spread over all or most of the operations. Officers', managers' and head overseers' salaries, automobile expenses incurred by them, as well as certain perquisites furnished the managers, are usually the items assembled under this account. It is closed into operations on a basis of total man days worked, as shown on the "distribution of labor." A more exact method would be to make a separate distribution of the head overseer's salary excluding from the basis the man days of operations over which he has no jurisdiction, such as pump and factory, and then joining the two sets of figures in one total column.

Turnout bonus, as its name implies, is an inducement offered the workers to secure a better turnout. It consists of additional payment to the worker of a certain percentage of the earnings, provided he turns out for work a specified minimum number of days. It is strictly an added labor cost and should be distributed over the accounts on the basis of labor values as shown on the "distribution of labor." A convenient way of prorating it is to provide an extra column on the latter, next to the total amount column for this purpose.

It will be remembered that the distribution of shop labor was embodied in the "distribution of labor" form. There remains, therefore, for distribution only the materials used in the shop, which, like the labor, had been charged under their specific shop symbols. This distribution is of course made on the same basis as was used for the labor portion of these shop costs.

Summary of Accounts Distributed. All these distributions, which can easily be worked out on one large sheet, ruled for the purpose, are then posted to a Summary Form, arranged somewhat as follows:

Down the extreme left side are listed the operating accounts —Groups I to VI inclusive. Then follow the necessary number of columns for lining up the complete costs, showing labor and material, etc., separately in each column. In the first of these are posted the direct costs—from the statement of expenditures previously referred to. Following this is posted in the respective columns against each account its share of the distributive accounts, as established by the various distributions described in detail above. The distributive items appearing in the various columns against each account are then cross-added, so that the total allocations to each account from whatever source are collected in one column. Adding these amounts to the direct expenses of the first column will yield the final costs for each account, the grand total of which, plus amounts distributed to other than operating accounts, should equal the original statement of expenditures, before elimination of distributive accounts.

An auxiliary statement, showing allocations to capital and other accounts, should be drawn up on the same form in order to tie up all figures and facilitate proving up the work.

All necessary data are now at hand to proceed with the apportionment of the monthly costs to crops and fields.

Determination of Crop and Field Costs

In most any piece of constructive work, a building, a bridge, a railroad or a steamship, we have first available the component parts and the problem is to put them together to achieve the finished structure.

In cost finding the problem is reversed. We have the total cost—the finished structure—and we proceed to dissect it to find the component parts, i.e., the detailed costs. So it is in the present instance. It will have been observed, from the plan described so far, that the total costs for each operation, computed as outlined in preceding paragraphs and recorded on the "summary statement," represent net costs; that is, the net balances derived from transactions recorded on *both* sides of the Ledger. The endeavor to ascertain the correct location, as to crops, for each cost item, demands therefore careful scrutiny and analysis of the Ledger pages in order to detect in the records special facts not apparent from the net figures and to accord them special treatment, if necessary.

It was stated early in this paper that about one half of the cultivated fields of a plantation constitute a "crop," i.e., the area designated to be harvested in any one year. There is on file at every plantation office a tabulation of the fields belonging to this crop and also the fields of the succeeding crop or, in other words, the remainder of the total fields.

On this known classification of fields rests the principle of crop cost distributor. Roughly, it consists in determining the allocation of costs to crops from the records of field labor kept in the back portion of the timebook or in some special "field distribution" book.

These record data are tabulated on large sheets—one for each crop running—provision being made for posting long term contract labor separately from day labor. These sheets each list the fields of the particular crop in a certain order, adhered to throughout, and opposite each field the man days worked are shown in columns headed according to operations. A blank column is provided next to each of the "days" columns for posting the long term contract labor figures—including the estimated future payment—and for prorating the day labor, when these figures become later available. It will, of course, be understood that these sheets merely furnish the basis for the *complete* distribution of costs over fields, since many other elements enter the computation, such as distributive costs, short term contract labor, various specific charges, etc., all of which must be considered and properly placed.

After these preliminary tabulations are completed the actual

work of allocation can begin. The distribution of the total costs over crops is made on a form having the cost accounts printed or typed down the left side, followed by as many vertical sections as crops are running, usually three, and one section for totals. The crop years running are inscribed at the head of each section and the word "Totals" at the head of the last section. All sections are sub-divided into four columns: Days, Labor, Material, Total.

The grand totals from the "summary of costs," previously compiled, may now be copied into the Labor, Material and Total columns of the last section of the form, headed "Totals."

The "Days" column of this section is still blank, the "Summary of Costs" having dealt with values only. But man days are an important unit of measurement and it is therefore logical that the *time* expended for auxiliary operations, as well as the *amounts* must be allocated to the direct operations. This distribution of the distributive days over direct days is accomplished on the same principle as the distribution of the corresponding values and the same bases are used. It is quite elaborate and requires a specially ruled form. When it has been completed the "Days" column in the "Totals" section of the "Crop Distribution" form is filled in.

For most of the operations in Group I, Preparation and Cultivation, the proportion of time and its cost in labor and material to be charged to each crop is found by applying the ratio of the known direct man days' time expended on the fields of the respective crops.

Example of Procedure.—The following example will illustrate the mode of procedure in its simplest form:

Assume that "Clearing Expense" shows the following net figures in the last column of the "Crop Distribution" form:

	Days	Labor	Material	Total
Clearing Expense	1,050	$2,200.00	$150.00	$2,350.00

This must be allocated to crops. By consulting the working sheets it is found that this particular work was done in a number of fields of all of the three crops running at that time. See page 373 as to how it looked on the working sheets.

The basic man days' time expended was therefore 1,000 days and the ratios for each crop are:

$$1925 \quad \frac{50}{1000} = .05$$

$$1926 \quad \frac{150}{1000} = .15$$

$$1927 \quad \frac{800}{1000} = .80$$

These ratios could now be applied to the net figures and the pro-

CROP 1925 CLEARING EXPENSE.

Fields	Basic Days		Labor		Material	
A	20					
B	30					
	50					

CROP 1926 CLEARING EXPENSE.

Fields	Basic Days		Labor		Material	
C	70					
D	80					
	150					

CROP 1927 CLEARING EXPENSE.

Fields	Basic Days		Labor		Material	
E	100					
F	50					
G	250					
H	400					
	800					

portions for each crop thus ascertained, if it were certain that no special transactions were involved to disturb these relative proportions. It is therefore necessary, before proceeding with the actual apportionments, to analyze the accounts in the general ledger and take note of all items which require specific treatment. Such items are credits of any kind, adjustments, settlements affecting a certain crop only, special payments, etc. Besides, all payments for contract work are chargeable specifically to certain crops and fields and must be so treated.

It is obvious that, unless any or all such special debits are first eliminated and reductions by credits restored, the true amount which is subject to distribution will not be disclosed and the distribution will therefore be incorrect.

In the case of "Clearing Expense," used as an illustration above, it is assumed that the general ledger showed a credit of $50 for work done the previous month and now transferred to another account. This work had been charged to Field G. There were also 50 distributive days to be allocated.

It is clear that the amount of labor to be prorated must be increased by $50 before the crop ratio is applied. The proportion of days and amounts for each crop will then be:

Crop	Ratio	Days	Labor	Material	Total
1925	.05	52 1/2	$ 112 50	$ 7 50	$ 120 00
1926	.15	157 1/2	337 50	22 50	360 00
1927			Cr. 50 00)		
	.80	840	1800 00)	120 00	1970 00
Totals	1.00	1050	$2200 00	$150 00	$ 2350 00

It will be noted that the specific credit of $50 due Field G has been deducted from the proportion of "Labor" allotted to Crop 1927, of which Field G is a part. These figures would now be entered on the Crop Distribution form and also at the foot of the respective columns in the working sheets, taking care, however, to prorate the *gross* labor amount of $1,800 over the fields of Crop 1927 and place a credit of $50 against Field G.

The final step is the work of prorating the footings of the different columns over the fields according to their respective basic days, which is merely a matter of routine work and is speedily accomplished by means of calculating machines.

This matter has been discussed at some length, because it furnishes the key to the greater part of the crop distribution work. The same principle underlies the mode of procedure in allocating most of the costs. A discussion of the exceptions and matters of special importance will suffice to make the presentation of the system complete.

Basis for Seed Cutting and Delivery. Among the operations of Group I there are some which require a more logical basis than man days' time for their equitable distribution over crops and fields. Cutting and hauling seed cane and the seed cane itself are such operations. Their cost is of course chargeable to the fields which receive the seed, while the fields which furnish it receive credit at the actual cost of producing the seed cane. The seed is cut and put in bags (usually by contract) ; then it is hauled to the fields where it is to be planted. Since locomotive time and mule labor are elements of cost in this work it is clear that the man days' time expended in cutting and hauling do not furnish a correct basis for distribution. A performance basis would be preferable and for this reason the distribution is based on the number of bags planted.

Charging of Initial Plant Cane Operations. In this connection it should be mentioned that the practice in Hawaii is to charge the entire cost of preparing and planting of fields to the crop year in which these fields are first harvested. This can be and has been argued. Theoretically there is no doubt that future ratoon crops should be made to bear a portion of these initial costs, since they certainly derive benefits therefrom. The question, however, is: How many ratoon crops should be charged? This has never been satisfactorily settled and therefore the old practice of charging one crop prevails. Considering that plant cane usually yields

much better than ratoons, the consequent increased profits in a measure offset the extra burden placed upon it.

Division and Allocation of Water Supply and Delivery Costs. Where an extensive pumping system is maintained, for lack of water supply from other sources, the equitable distribution of these costs requires special thought. Since the costs of pumping and delivery of water, including repairs, must be borne by the fields receiving it, the time spent in irrigation is the logical basis for distributing them.

According to their location and geological condition, different fields consume different quantities of water, which is lifted by the pumps to greatly varying "heads" or elevations. For this reason the application, generally, of the time element for distribution purposes will not reflect the cost per field as accurately as desirable. It is possible, however, to compute and keep on file for monthly use a schedule of fixed groups of fields each of which bears an established percentage of the total costs.

The height to which water has to be lifted and the relative quantities pumped to each lift bear directly on the cost. The computation of the above schedule is therefore based on these two factors by grouping fields of approximately the same elevation under an optional number of average lifts and establishing the percentage of total cost to be borne by each group from the relative quantities of water delivered to the fields composing it. The distribution of the group cost so determined is then based on irrigation man days and carried out in the manner before described.

Special Form for Long Term Contract Operation. Reference has been made several times in the text to "Long Term Contracts" and their nature explained. The principal classes of work included in the terms of such contracts are irrigating, weeding, and applying fertilizers. An analysis of the cost elements of these operations is best made on a special form in order to determine the correct distributable days and amounts as well as to deal in-

Operation:

1	2	3	4	5	6	7
Crop	Days Day Labor	Days Long Term Contract	Total Days	Distrib'ble Days	Long Term Contr. Amounts	Distrib'ble Amounts
Totals:						

8	9	10	11	12	13	14
Settlements	Special Labor Credits	Day Labor	Net Total Labor	Gross Mat'l.	Special Mat'l. Credits	Net Mat'l.

telligently with the specific items.

Such a form is shown above, the columns having been numbered for easy reference.

Column 1 shows the crops running at the time; column 2 shows the man days' time spent at day labor; column 3 shows the man days worked at long term contract labor; column 4 is the total of columns 2 and 3; column 5 shows the distributive days (total obtained from the "Distribution of Days"); column 6 contains the amounts advanced long term contractors plus the estimated future payments; the total for column 7 is obtained from the "Summary of Costs," the crop proportions being calculated by applying the percentage of total days computed from column 4. This also applies to column 5. Column 8 records the aggregate total of adjustments necessary to reconcile the estimated long term contract labor with the actual settlements. The detail, as it affects the various fields, is, of course, available from the journal entry. Naturally these figures affect only the current crop. Column 9, special credits, is self-explanatory. Since all elements comprising the total net labor, entered from the "Summary of Costs" at the foot of column 11, have now been segregated, it is evident that the difference between the sum of the footings of columns 6, 7, 8, and 9 and the total net labor at the foot of column 11 must be the amount of total "day labor" corresponding to the man days of "day labor" in column 2. It is therefore apportioned over crops in the ratio established by column 2. The crop amounts of day labor so obtained are then transferred to the Field Distribution Sheet and prorated over the fields according to the direct man days shown there against each field. They are later posted to the field cost working sheets to be included with the other cost elements worked out on these.

Distribution of Other Items

The application of fertilizers is often made on a piece work basis. Of course in such cases, as in fact in every case of contract work where the exact expenditure and fields incurring it are known,

these exact amounts are charged against the fields. Care must be taken, however, to include with the day labor the time spent at such contract labor, when establishing the basis for the allocation of distributive cost items. The specially prepared and costly commercial fertilizers, which form a very considerable cost factor, should be accounted for by careful field and warehouse check and recorded in a book designed to show clearly receipts and disbursements to individual fields, in order that these costs may be correctly placed.

With the operations classed under Group II, Harvesting, the question of allocation to crops does not arise. During the progress of the grinding season the cost of these operations is, of course, charged to the current crop. During the off-season, that is, the period between completion of one crop and beginning of the next, purchases of supplies, small tools, etc., are charged to the next crop, while the cost of repairs of equipment, chargeable to harvesting operations, such as portable track, is borne by the preceding crop, since it caused the wear.

The basis used for distribution of costs over fields is "Tons of Cane." The chemist's monthly report, showing each month the areas of fields harvested, tons of cane ground and tons of sugar manufactured, furnishes the information.

Portable track repairs which occur at odd times during the year and have no relation to the fields harvested in any one month, cannot therefore properly be charged against the fields harvested that month, but should be held in a field suspense account and charged against all the fields of the crop at the end of the year.

Group III, Manufacturing, like Harvesting, is all chargeable to the current crop and the costs are charged against the fields harvested, on the basis of tons cane ground, for all operations, except marking of the bags and the bags themselves, containers expense. For this latter cost the logical basis is "Tons of Sugar" manufactured.

The "off-season" repairs of the plant are borne by the preceding crop on the theory that this crop is responsible for the conditions necessitating the repairs. To insure an equitable field cost distribution, the repairs should likewise be held in suspense and distributed over all fields of the crop at one time.

Laboratory work during the off-season, such as soil analyses, etc., should be charged to future crops and fields according to the nature of the work done.

The last three Groups IV, V and VI, Repairs, Sanitation, and General Expenses, can be dealt with jointly, being, from a distribution standpoint, of the same general nature. There was a time when the plan pursued in spreading these costs was their arbitrary division into three equal parts; and possibly this plan is still in use on some plantations. It is mainly objectionable because it is arbitrary.

A basis common to all plantations is the relative area of the

respective crops. This has the advantage of being quite logical in its application to most of these sundry items, and, save under exceptional conditions, not subject to great variations as between the relative proportions of any given three, or more, crops. The distribution over fields of each crop is, of course, also on an area basis, the "new crop" fields assuming the burden as the area of the progressing harvest diminishes and the "middle crop" fields being charged with an approximately fixed amount.

The remarks made previously, as to specific items, apply here also; the principal exceptions being rent and taxes, the treatment of which with respect to crops was fully discussed on page 367.

With respect to fields the basis for distribution of rent depends on the nature of the rental. If it consists of a percentage of the returns from the sale of sugar, the relative tonnage of sugar produced would probably be the most logical basis: If, on the other hand all of the rent, or a portion, consists of a fixed amount on a certain area, but not specifically designated fields, then the distribution over fields should be made in the ratio which the individual field areas bear to the total area so rented.

The respective share of the taxes distributable to each field of the various crops is determined by its value at the end of the fiscal period, each field being charged in relative ratio. This, again, is logical, since taxes are levied on the assessed value of the enterprise, which certainly includes the growing crops.

Where insurance on growing cane is in force, the premiums applicable to this insurance, being chargeable to a specific crop and fields, must be so assigned The remaining insurance cost is then distributed together with the other general costs as above stated.

The foregoing paragraphs contain all the information necessary to complete the entire crop and field distribution.

The costs of every operation for each field are then accumulated monthly to the field books (one for each crop), which consequently show the total cost to date every month, with the exception of certain items in suspense, previously alluded to, which are distributable over all fields at the end of the fiscal period.

There is one other cost factor, which, while it does not enter into the monthly distribution problem must be allocated to crops and fields once each year. This is depreciation. It is not within the scope of this paper to discuss the various methods of dealing with this subject and for this reason mention of it was omitted in that section of the text which deals with the general accounts. Suffice it to say that, whichever the method, all plantations make provision for depreciation and therefore all must deal with the problem of spreading its cost over crops and fields, if their aim is to arrive at reliable cost figures.

The principle to be followed in making the allocation is much the same as that governing the distribution of the monthly costs, namely, to find a logical basis according to the nature of the asset. Thus, depreciation on all permanent improvements and such equip-

ment which cannot well be assigned a specific basis might be spread over crops on the basis of relative area. The depreciation of the factory (building and machinery), caused directly by the process of manufacture, could logically be charged to the current crop each year. The relative crop cost of pumping for the year would furnish an equitable basis for the depreciation on the entire pumping equipment and improvements connected therewith, such as waterways, flumes, reservoirs, pipe lines, and wells.

Depreciation of steam plows and tractors could be charged to the crops on which work was performed by these implements.

About three-fourths of the total work of locomotives and cars is the hauling of cane; the rest of the work is of a miscellaneous nature. It is therefore reasonable to allocate the depreciation in the same ratio, that is, charge 75% to the crop or crops for which cane was hauled during the fiscal year and distribute the remaining 25% on the basis of area over all crops.

Depreciation of live stock and stable equipment could be distributed on the basis of animals. From the cumulated record of animal work done, which is used in the monthly distribution of stable expense, a segregation can be made at the end of the year, classifying the work by crops, as far as apparent. This segregation may account for, say, 65% of the total animal labor and can be spread over crops in the ratio shown for each crop; the balance of 35%, not being of a specific nature, may then be distributed on the basis of relative area over all the crops.

The distribution of these depreciation costs over individual fields is made on the basis of their relative areas, and, when posted to the field book, completes this record.

Passing mention need only be made of the last cost factor, marketing expense. Its treatment presents no special point of interest, its cost being wholly chargeable, of course, to the crop incurring the expense and to the fields according to tons of sugar produced from them.

Exhibits

From these detailed cost data it is possible to compile monthly comprehensive sets of exhibits reflecting not only the expenditures in time, labor, and materials for each operation, and its division over crops, but also the financial status of each crop to date of accounting.

At the end of the fiscal year the following cost statistics can also readily be compiled from the data assembled during the year.

1. *Operating Costs for the Year.*
   This can be made to show the cost of each operation during the year, sub-divided both into crops and into labor and material.
2. *Cost of Production of Current Crop.*
   This may be arranged to show in separate columns the

amounts expended on the crop during the years (usually three) of its growth, these figures summarized and grouped according to labor and material and the total of these. "Acre" and "Ton" unit costs at the margin complete the statement.

3. *Marketing Expense.*

   On this can be shown the detail of the elements composing this cost factor: Tons shipped, destination, detail of local and mainland charges and the cost per ton sugar of each of these.

4. *Depreciation.*

   A comprehensive way to arrange this is to show the distribution over crops of the depreciation charged on the various assets and also a final column showing the total depreciation charged during the years the crop was in growth.

5. *Field Cost Statement for Current Crop.*

   This will be a complete statement of unit costs, both per acre and per ton sugar, by fields and by operations. It will show the cost to produce; to market; proceeds; profit or loss per acre and per ton sugar; and also cane and sugar data.

While it is realized that the system of crop and field costing here described leaves room for improvement, there is no question that strenuous efforts are exerted in every plantation office, to get close to the facts. It is imperative to know accurately the limits of profitability in field and factory, in order so to steer the ship that even the present low price of sugar will not pile it on the rocks.